HYDROLOGIC ANALYSIS FOR:

CROCKER TPM 20743

IN THE
COUNTY OF SAN DIEGO

REVISED
SEPTEMBER, 2004

PREPARED FOR:
ARNOLD D. CROCKER &
SUN B. CROCKER
393 GALLOWAY VALLEY COURT
ALPINE, CA 91901

PREPARED BY:
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SOLANA BEACH, CA 92075
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REGISTERED PROFESSIONAL ENGINEER
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CIVIL
STATE OF CALIFORNIA

JONES
ENGINEERS, INCORPORATED

October 8, 2004

Department of Public Works
County of San Diego
5555 Overland Ave., Bldg. 2
San Diego, CA 92123

Re: Hydrologic Analysis for Crocker TPM 20743

This letter accompanies the attached *Hydrologic Analysis for Crocker TPM 20743* and serves to indicate revisions per the Department of Public Works (refer to attached letter, dated September 2, 2004). The following comments were addressed:

- Identify the 100 year limit of inundation along the creek parallel to the westerly property line, effecting this property. Refer to Pre and Post Development Drawings.

- Cross section stop at the southerly property line. Continue cross section analysis along the creek within the proprety to the point affecting the westerly property line. Analysis for continuation of 100 yr flood line of inundation and added cross sections are located in Appendix II (Section 17 and 18).

- Pre and post development Q's were done for the entire basin. Perform similar calculations for the Lot only to show the effect of increase in % impervious within the lot. Refer to Section 6.1 and Figures 3 and 4 in the Hydrologic Report.

- Using the result in 3 above, provide capacity calculations for the existing 24″ culvert west of the westerly boundary. If this culvert should prove insufficient, provide mitigation measures. As-built records specify 90 linear feet of 48″ CMP at a slope of 18.8%. Hydraulic calculations are located in Appendix III.

Please do not hesitate to call if you have questions.

Sincerely,

R K Burdette Jr.

Robert K. Burdette, Jr.
RCE 20905

535 North Highway 101, Suite "J"
Solana Beach, Ca. 92075

(858) 847-0011 FAX (858) 847-0022 LAND USE PLANNING/CIVIL ENGINEERING/LAND SURVEYING

3. Pre and post development Q's were done for the entire basin. Perform similar calculations for the Lot only to show the effect of increase in % impervious within the lot.

3. Using the result in 3 above, provide capacity calculations for the existing 24" culvert west of the westerly boundary. If this culvert should prove insufficient, provide mitigation measures.

If you have any questions regarding the drainage report, please contact Miles Safa at (858) 694-3265.

Preliminary Staff Archaeological Review:

The scoping letter dated June 18, 2003 required a preliminary archaeological review of the project area because of the high potential for archaeological sites and features. The high potential was determined because of the presence of several sites within a one-mile radius of the project area, numerous granitic bedrock outcroppings and a significant drainage with riparian oak trees. County of San Diego staff surveyed the portion of the property not already in use with an existing residence and landscaping on August 30, 2004. Ground visibility was good in most areas because of the recent Crest Fire. However, no artifacts or features were identified. Because the project is proposing open space easements in the area of the drainage and steep slopes, no further reports, testing or monitoring will be required.

If you have any specific questions regarding these comments, please contact Gail Wright, Project Environmental Analyst at (858) 694-3003 or by e-mail at gail.wright@sdcounty.ca.gov.

PROJECT SCHEDULE: An updated copy of your project schedule is attached showing an estimated hearing/decision date of 4/13/2005.

SUBMITTAL REQUIREMENTS: Unless other agreements have been made with County staff, you must comply with the following submittal requirements in order to make adequate progress and to minimize the time and cost in the processing of your application:

1. Submit a copy of this letter.

2. If replacement maps or plot plans are to be submitted, provide a narrative supplemented by a project map or plan of appropriate scale and legibility with all deviations "Redlined."

3. Submit a separate letter that indicates specifically where and how each of the above comments is addressed in the revised information/documents. For simple

2. A 25 ft buffer is not adequate to protect the southwestern RPO drainage onsite. This buffer should extend at least 50 ft and there should be contiguity with the dedicated open space offsite to the south. Additionally, the open space must extend 50 ft from the drip line of any oak trees.

3. The RPO drainage at the northeast corner of the property appears to continue along the northern property line (either onsite or offsite). Please show the complete RPO drainage limits onsite and within 100 ft of the site.

4. It is not clear why the vegetation is mapped as Engelmann Oak Woodland both onsite and offsite in the general vicinity of the northern property boundary. The only oak woodland appears to be immediately adjacent to and north of Galloway Valley Court. Please revise the biological resources map to reflect the correct vegetation type (southern mixed chaparral) and the fact that there are houses within 100 ft of the northern property line.

5. The project site is not considered a BRCA as is stated on page 20 (and should be stated in Section 2.0). Therefore mitigation should take place offsite within a BRCA at a ratio of 1:1. Onsite mitigation is not the preferred location as it does not contribute to the goals of the MSCP. Please note the currently proposed open space is required by the Resource Protection Ordinance. This habitat is considered impact neutral, neither impacted nor given credit for loss of habitat.

6. Please provide an open space map (preferably project scale) that clearly shows the proposed preservation and project impacts including fire clearing.

7. Please include a discussion of any offsite impacts associated with required road improvements and if necessary propose mitigation.

Hydrologic Analysis

Department of Public Works staff has reviewed the Drainage Study by Jones Engineering received 8-02-04 and has the following comments:

1. Identify the 100 year limit of inundation along the creek parallel to the westerly property line, effecting this property.

2. Cross section stop at the southerly property line. Continue cross section analysis along the creek within the property to the point affecting the westerly property line.

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PURPOSE AND OBJECTIVES

The purpose of this report is to evaluate stormwater runoff resulting from the proposed development of the Crocker subdivision during a design flood event according to the requirements of the County of San Diego.

EXISTING CONDITIONS

The project is located south of Interstate 8 and east of the terminus of Galloway Valley Court within the Alpine Heights area of Alpine California (Figures 1 and 2). The property currently has an existing single-family residence with accessory buildings.

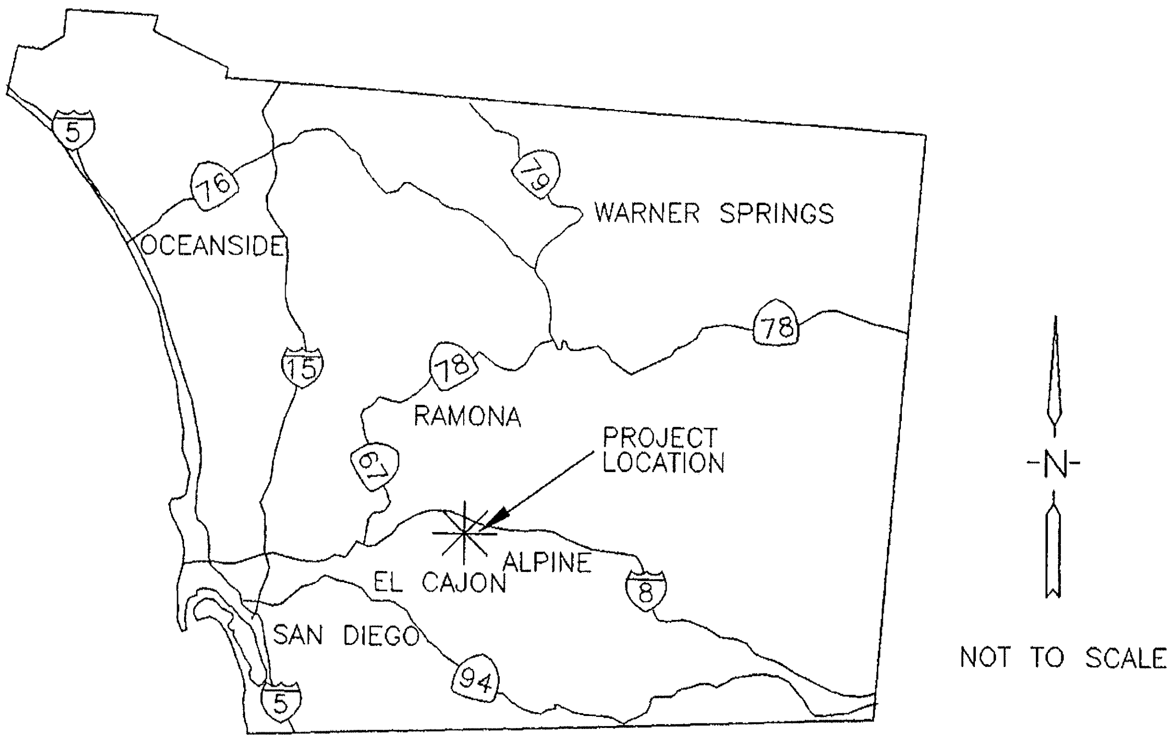
The *USDA's Soil Survey of San Diego Area, California* identifies the soil on the subject property as Hydrologic Group C, consisting of Cieneba-Fallbrook rocky sandy loams, 30 to 65 percent slopes (CnG2), and Fallbrook rocky sandy loam, 9 to 30 percent slopes (FeE2). The soils within the drainage basin are predominately Hydrologic Group C, consisting of Fallbrook sandy loam, 9 to 15 percent slopes, eroded (FaD2). There also exists a small section of Hydrologic Group B soils; specifically, Cieneba rocky coarse sandy loam, 9 to 30 percent slopes, eroded (CmE2) and Vista coarse sandy loam, 30 to 60 percent slopes, (VsG) (Appendix I).

Stormwater runoff from the property drains westerly to Galloway Valley and then south through Harbison Canyon to the North Fork of the Sweetwater River Watershed.

PROPOSED DEVELOPMENT

The tentative parcel map includes 2 single-family residential lots. Parcel 1 (2.18 acres) is developed with a single-family residence. Parcel 2 (2.15 acres) is located to the south with a proposed building site (1400 sf pad) to be graded to allow stormwater drainage to traverse the existing natural route.

There is existing legal access from Harbison Canyon Road (a publicly maintained roadway) by a 40-ft private road easement along Galloway Valley Court and Galloway Valley Road.



JONES
ENGINEERS

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4164 Meridian Street • Suite 200 • Bellingham, Washington 98226

LOCATION MAP

FIGURE 1

PROJECT LOCATION

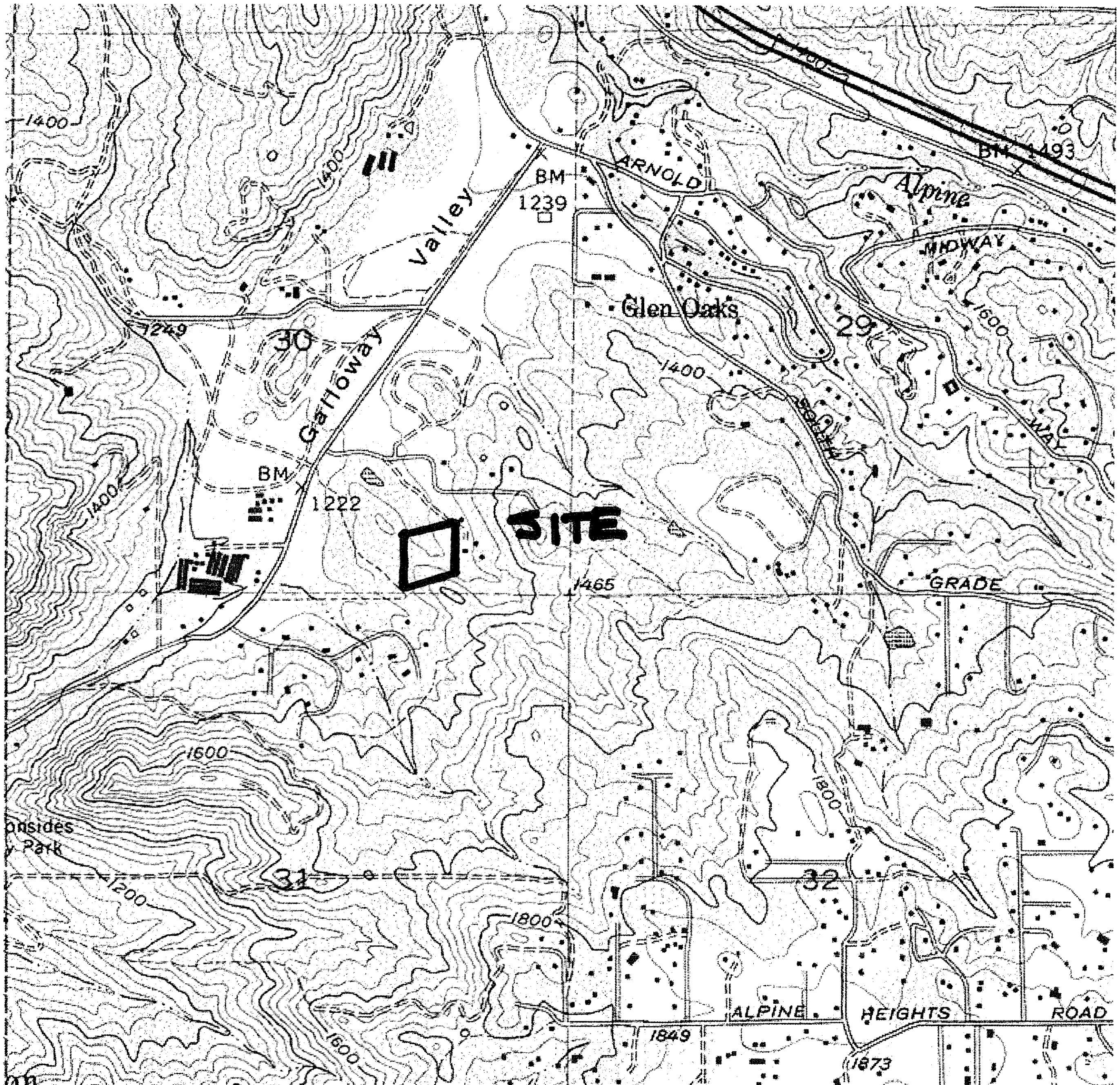

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Figure 2
1:2000

METHOD OF ANALYSIS

The hydrologic analysis for this project is consistent with current engineering standards and the requirements of San Diego County Department of Public Works. The rational method was used to determine the maximum flow rate resulting from the 100-yr, 6-hour design storm event using the current *County of San Diego Drainage Manual's* isopluvial map data (Appendix I).

Peak flow rates were computed for existing and post developed conditions. All analyses for the upstream drainage area are included in the *Hydrology Report for Alpine Ranch Estates West II,* (submitted to the County of San Diego) prepared by Jones Engineers, Inc., July, 2004. The time of concentration resulting from the developed condition of the Alpine Ranch Estates (currently under construction) has been incorporated in both the existing and post development hydrologic analysis for Crocker TPM. Therefore, all upstream development has been accounted for, and only the development of the project site will affect peak discharge flow rates.

ANALYSIS

6.1 Drainage Analysis

One point of concentration was identified in the pre and post development analyses. Intensity was calculated using the precipitation maps found in the *Drainage Manual* for each basin using the following equation:

$$I = 7.44 P_6 D^{-0.645}$$

Where P_6 = 2.99 inches (Appendix I)
D = varies with basin size and travel path.

The project site (encompassing 4.3 acres) contains an impervious area summation in the existing condition of 0.36 acres. The amounts of impervious and pervious areas were incorporated with land usage and soils to calculate a composite runoff coefficient for the drainage basin. The coefficient was calculated based on a Cp value of 0.30 to reflect undisturbed natural terrain for type C soils and impervious percentage using the following formula with the conservative assumption that the driveways and pads are 100% impervious:

$$C = 0.90 \times (\%\ \text{Impervious}) + C_p \times (1\text{-}\%\text{Impervious})$$

The following equation was used to analyze travel times for overland flow:

$$Tc = \left(\frac{11.9L^3}{h}\right)^{0.385}$$

Where L = travel length and h = beginning minus ending elevations (E_1-E_2).

Pre-Development Hydrologic Analysis

An initial time of concentration (T_i) was based on a maximum overland flow length of 100 feet and travel time (T_f) was calculated through the watershed using the overland flow equation, and channel flow analysis from Haestad Methods Open Channel Flow Module, Version 3.3 © 1991. The T_c for the Crocker Parcel in the existing condition was determined to be 10 minutes with a corresponding peak flow rate of 7.5 cfs (Figure 3).

Table 1: Crocker Parcel Pre-Development Analysis

Crocker Parcel Pre-Development :															
Run	**Area** (acres)	**Sum Area**	**C**	**CxA**	**Sum CxA**	**Flowpath Desc.**	**Flow Length** (ft)	**E1** (ft)	**E2** (ft)	**h** (ft)	**Slope** (ft/ft)	**V** (ft/s)	T_f (min)	T_C (min)	I_{100} (in/hr)	Q_{100} (cfs)
		0.00			*0.00*											
	4.30		0.35	1.51		initial time	100				0.10		6.90			
L1						overland flow	352	1440	1368	72	0.20		1.31			
L2						channel	161.6	1368	1366	2	0.01	2.83	0.95			
L3						culvert	90	(as built specs)			0.19	11.01	0.14			
L4						channel	396	1360	1295	65	0.16	8.07	0.82			
		4.30			***1.51***						***total =***		***10.12***	***10.12***	5.00	7.52

Post-Development Hydrologic Analysis

The project site contains an impervious area summation in the developed condition of 0.60 acres. T_i was based on a maximum overland flow length of 100 feet and T_f was calculated through the watershed using the overland flow equation, and channel flow analysis. The T_c for the Crocker Parcel in the developed condition was determined to be 10 minutes with a corresponding peak flow rate of 8.2 cfs (Figure 4).

Table 2: Crocker Parcel Post-Development Analysis

Crocker Parcel Post-Development :																
Run	**Area** (acres)	**Sum Area**	**C**	**CxA**	**Sum CxA**	**Flowpath Desc.**	**Flow Length** (ft)	**E1** (ft)	**E2** (ft)	**h** (ft)	**Slope** (ft/ft)	**V** (ft/s)	T_f (min)	T_C (min)	I_{100} (in/hr)	Q_{100} (cfs)
		0.00			*0.00*											
	4.30		0.38	1.63		initial time	100				0.10		6.90			
L1						overland flow	352	1440	1368	72	0.20		1.31			
L2						channel	161.6	1368	1366	2	0.01	2.83	0.95			
L3						culvert	90	(as built specs)			0.19	11.27	0.13			
L4						channel	396	1360	1295	65	0.16	8.07	0.82			
		4.30			***1.63***						***total =***		***10.12***	***10.12***	5.00	8.17

PRE-DEVELOPMENT HYDROLOGY CROCKER PARCEL

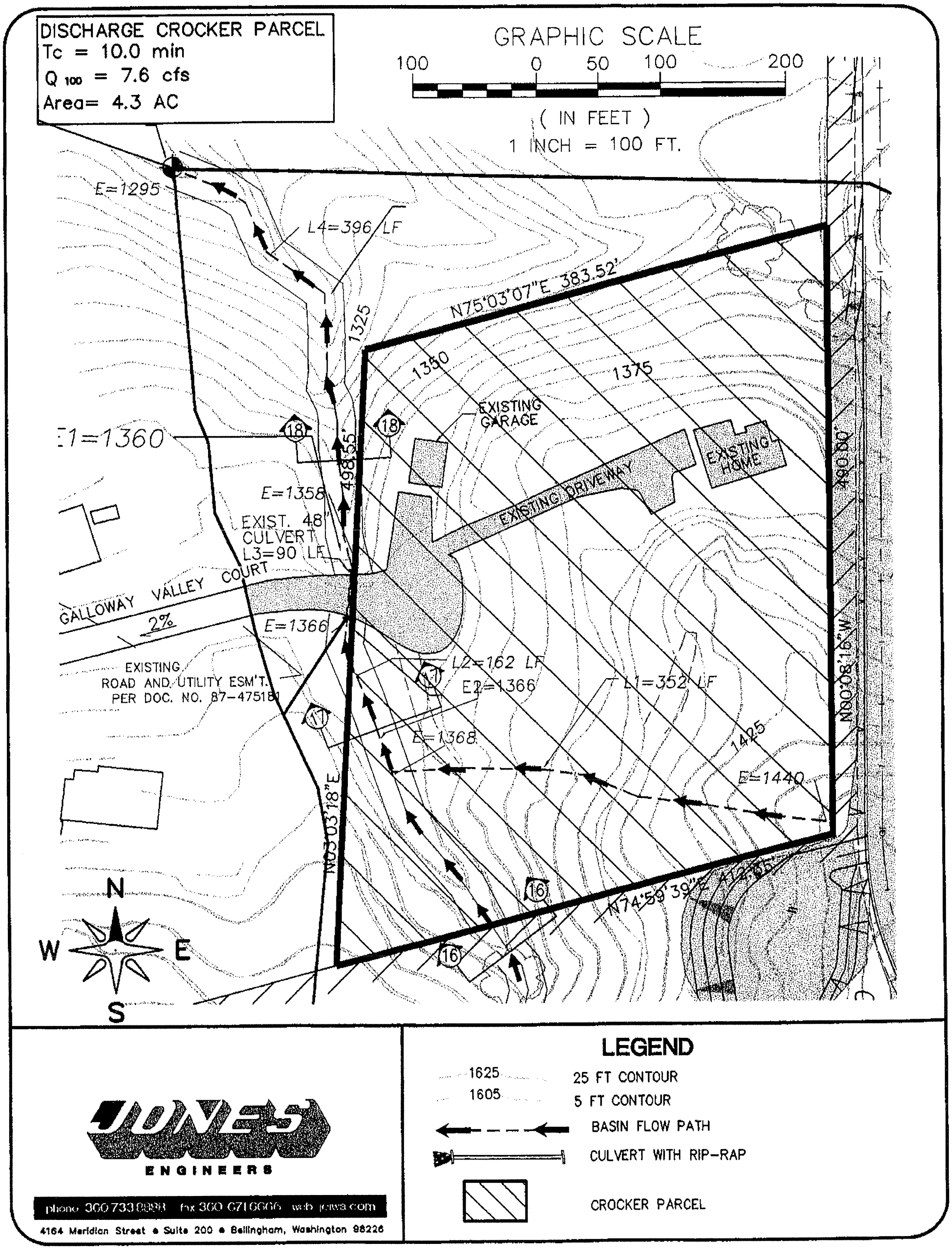
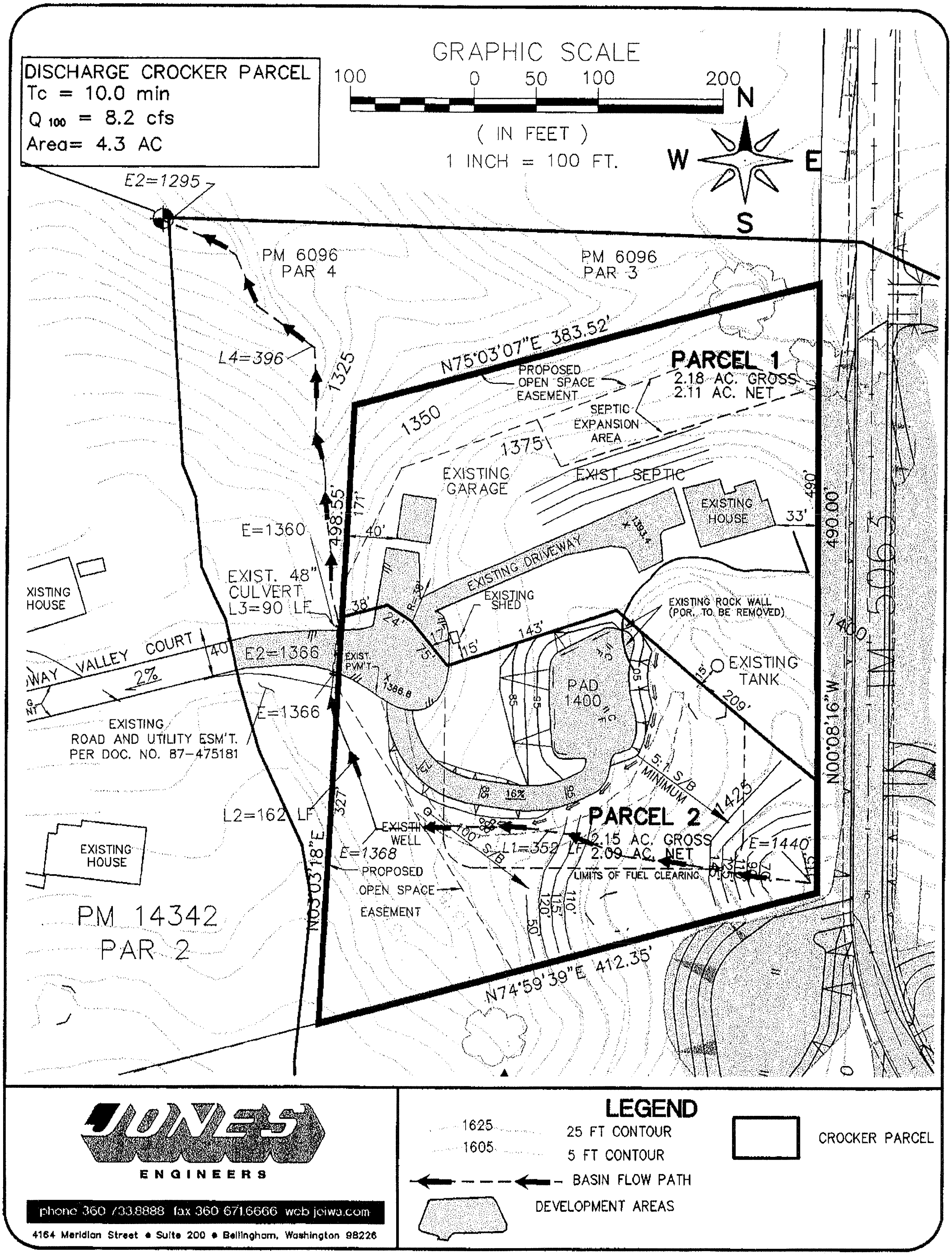


FIGURE 3

POST-DEVELOPMENT HYDROLOGY CROCKER PARCEL



6.2 Hydraulic Analysis

The drainage basin encompasses approximately 105.5 acres which contribute runoff to the identified POC. Appendix II contains calculations for the identified 100-year lines of inundation for the natural channel in the drainage basin (see attached drawings). The cross-section analysis has been continued through the Crocker Parcel (cross sections 17 and 18). The hydraulic analysis evaluates the entire drainage basin in order to provide capacity calculations for the existing 48" culvert west of the westerly boundary. The flow through the existing pipe was calculated using Haestad Methods Inc. Open Channel Flow Module Version 3.3 © 1991 (Appendix III).

The runoff coefficient was calculated based on Cp values reflecting low density residential usage for Hydrologic Type C and B soils. Although the drainage basin does contain type B soils; the runoff coefficient is not influenced due to the small percentage of total area.

Table 3: Drainage Basin Runoff Coefficient

Drainage Basin (acres) = 105.50					
Hydrologic Group		**% of Total Area**	**Area**	**CN**	**A x CN**
C		94	99.17	0.36	35.70
B		6	6.33	0.32	2.03
	Sum	100	105.50		37.73
	Mean Antecedent Curve Number			0.36	

Note: Runoff Coefficient values based on Low Density Residential - Appendix I

The summation of the development within the upstream portion of Alpine Ranch Estates and the existing single-family residence located on Parcel 1 of Crocker TPM results in a total impervious area of 10 acres. Proposed development within the project site results in an increase of 0.24 acres to the total impervious area. The travel path and subsequent time of concentration are identical for the pre and post development condition. The runoff coefficient was not affected by the proportionally small increase in impervious area.

The *Hydrology Report for Alpine Ranch Estates West II*) submitted to San Diego County, July 2004, identifies a time of concentration of 21.6 minutes for the developed condition of the drainage basin (labeled Basin III). T_i was based on a maximum overland flow length of 100 feet T_f was calculated through the watershed using the overland flow equation.

Table 4: Analysis from Alpine Ranch Hydrology Report

POST-DEVELOPMENT BASIN III

100'@10% t_i = 6.9 min
Natural channel L=2683' E1=1850' E2=1516' h=334' t_t=7.6 min
t_s = 4.3 min
Culvert = 0 min
Lined Channel = 0 min
Natural Channel L=821' E1=1505' E2=1375' h=130 t_t=2.8 min
t_c = 21.6 min

The calculation was modified to reflect the additional drainage area and continuation of the travel path through the Crocker parcel to the existing culvert located at Galloway Valley Court and to the specified POC.

Table 5: Pre-Development Analysis

DRAINAGE TO CULVERT AT GALLOWAY VALLEY COURT

100'@10% t_i = 6.9 min
Natural channel L=2683' E1=1850' E2=1516' h=334' t_t=7.6 min
t_s = 4.3 min
Culvert = 0 min
Lined Channel = 0 min
Natural Channel L=1087' E1=1505' E2=1366' h=139 t_t=3.8 min
t_c = 22.6 min

The comprehensive T_c for the drainage basin to the POC was determined to be 23.5 minutes with a corresponding peak flow rate (Q_{100}) of 110 cfs. All calculations are located in Appendix III.

Table 6: Drainage Basin Pre-Development Analysis

Drainage Basin	**$Area_{Total}$** (acre)	**$Area_{Imp}$** (acre)	**A_{Imp}/A_T**	**C_P**	**C**	**T_t** (min) 21.6	**i_{100}** (in/hr)	**Q_{100}** (cfs)
Existing	105.5	10.0	0.095	0.30	0.36	23.5	2.90	110.3

Table 7: Drainage Basin Post Development Analysis

Drainage Basin	**$Area_{Total}$** (acre)	**$Area_{Imp}$** (acre)	**A_{Imp}/A_T**	**C_P**	**C**	**T_t** (min)	**i_{100}** (in/hr)	**Q_{100}** (cfs)
Developed	105.5	10.2	0.097	0.30	0.36	23.5	2.90	110.3

Conclusion

Based upon the preceding analysis, the proposed development will not have a hydrologic impact on the residential lots or offsite property.

Appendix I: Hydrology

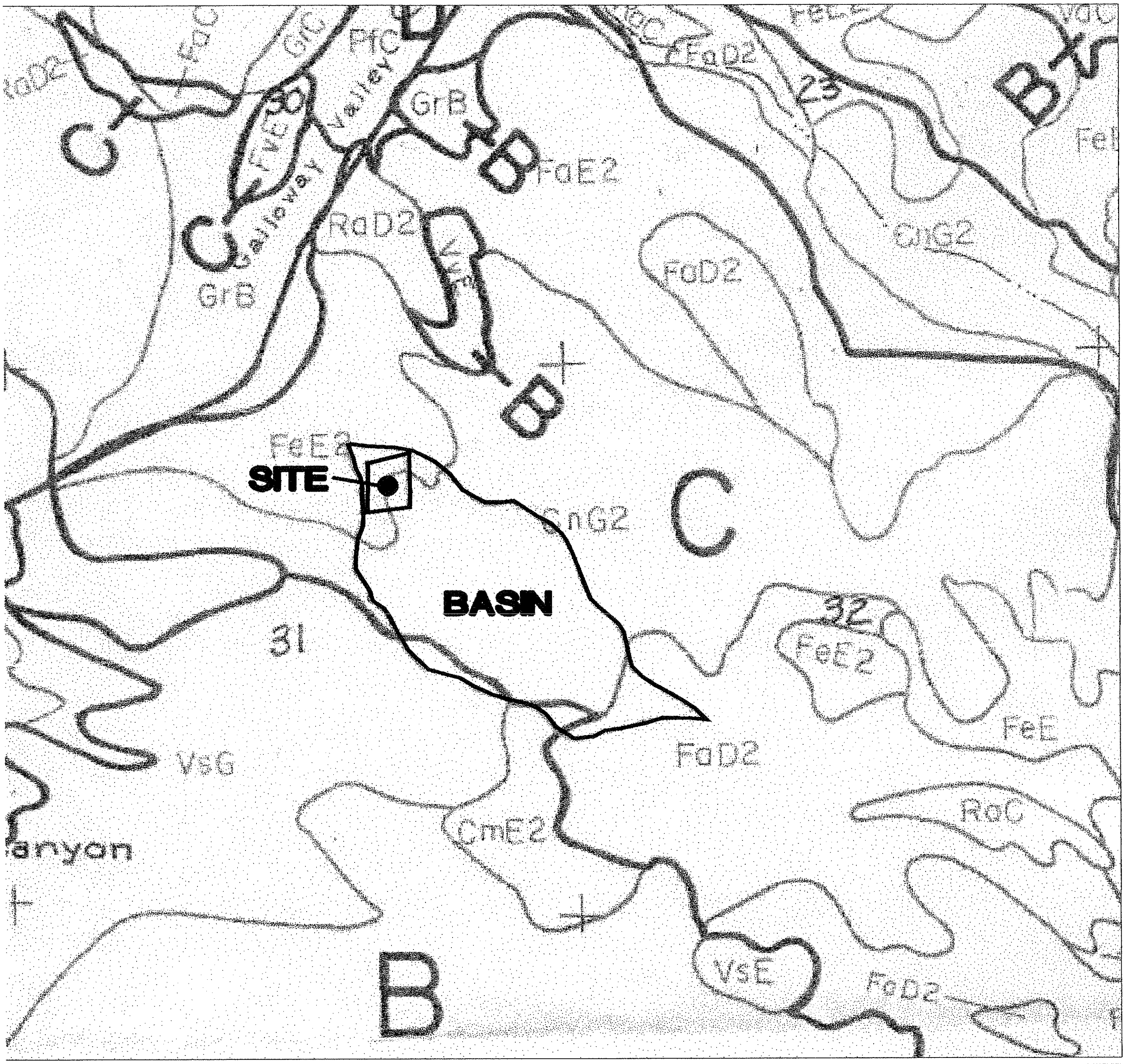
Soil Survey, San Diego Area, CA

Runoff Coefficients

Isopluvial Maps

Intensity-Duration Design Chart

Overland Time of Flow Nomograph



LEGEND

N
W E
S

DRAINAGE BASIN
SCS SOIL TYPE DELINEATION
CmrG SCS SOIL TYPE DESIGNATION
C HYDRAULIC GROUP
PROJECT SITE

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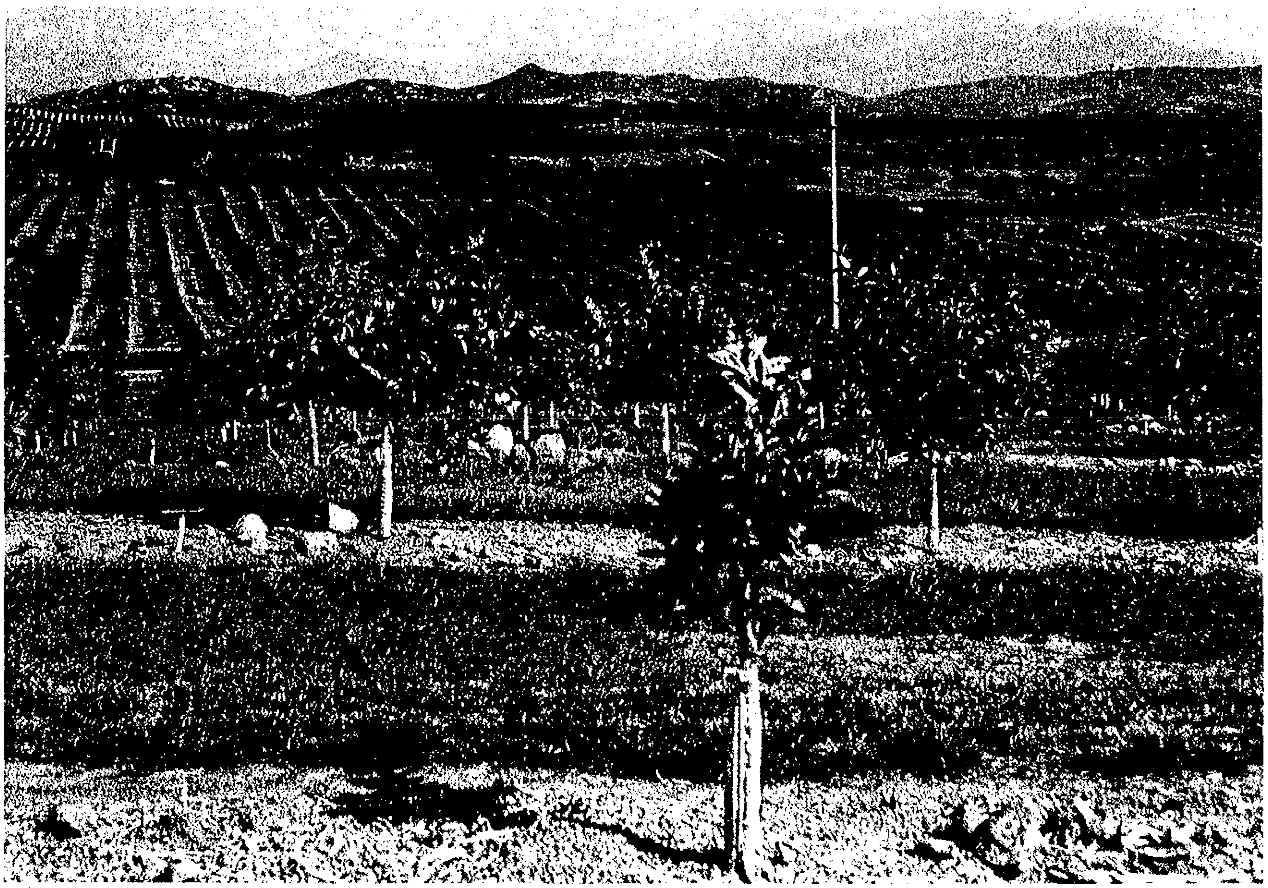
SOILS MAP

NOT TO SCALE

PART II

SOIL SURVEY

San Diego Area, California



UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service and Forest Service
in cooperation with
UNIVERSITY OF CALIFORNIA AGRICULTURAL EXPERIMENT STATION
UNITED STATES DEPARTMENT OF THE INTERIOR
Bureau of Indian Affairs
DEPARTMENT OF THE NAVY
United States Marine Corps

Issued December 1973

TABLE 11.--INTERPRETATIONS FOR LAND MANAGEMENT--Continued

Map symbol	Soil	Hydro-logic group	Erodibility	Limitations for conversion from brush to grass
CaD2	Calpine coarse sandy loam, 9 to 15 percent slopes, eroded.	B	Moderate 2	Slight. 4/
CbB	Carlsbad gravelly loamy sand, 2 to 5 percent slopes	C	Severe 2	Slight.
CbC	Carlsbad gravelly loamy sand, 5 to 9 percent slopes	C	Severe 2	Slight.
CbD	Carlsbad gravelly loamy sand, 9 to 15 percent slopes	C	Severe 2	Slight.
CbE	Carlsbad gravelly loamy sand, 15 to 30 percent slopes	C	Severe 2	Slight.
CcC	Carlsbad-Urban land complex, 2 to 9 percent slopes	D		
CcE	Carlsbad-Urban land complex, 9 to 30 percent slopes	D		
CeC	Carrizo very gravelly sand, 0 to 9 percent slopes	A	Severe 2	
CfB	Chesterton fine sandy loam, 2 to 5 percent slopes	D	Severe 9	Slight.
CfC	Chesterton fine sandy loam, 5 to 9 percent slopes	D	Severe 9	Slight.
CfD2	Chesterton fine sandy loam, 9 to 15 percent slopes, eroded.	D	Severe 9	Moderate.
CgC	Chesterton-Urban land complex, 2 to 9 percent slopes:			
	Chesterton	D		
	Urban land	D		
ChA	Chino fine sandy loam, 0 to 2 percent slopes	C	Severe 16	Slight.
ChB	Chino fine sandy loam, 2 to 5 percent slopes	C	Severe 16	Slight.
CkA	Chino silt loam, saline, 0 to 2 percent slopes	C	Moderate 2	Moderate.
ClD2	Cieneba coarse sandy loam, 5 to 15 percent slopes, eroded.	B	Severe 16	Severe.
ClE2	Cieneba coarse sandy loam, 15 to 30 percent slopes, eroded.	B	Severe 16	Severe.
ClG2	Cieneba coarse sandy loam, 30 to 65 percent slopes, eroded.	B	Severe 1	Severe.
CmE2	Cieneba rocky coarse sandy loam, 9 to 30 percent slopes, eroded.	B	Severe 16	Severe.
CmrG	Cieneba very rocky coarse sandy loam, 30 to 75 percent slopes.	B	Severe 1	Severe.
CnE2	Cieneba-Fallbrook rocky sandy loams, 9 to 30 percent slopes, eroded:			
	Cieneba	B	Severe 16	Severe.
	Fallbrook	C	Severe 16	Severe.
CnG2	Cieneba-Fallbrook rocky sandy loams, 30 to 65 percent slopes, eroded:			
	Cieneba	B	Severe 1	Severe.
	Fallbrook	C	Severe 1	Severe.
Co	Clayey alluvial land	D	Moderate 2	Slight.
Cr	Coastal beaches	A	Severe 2	
CsB	Corralitos loamy sand, 0 to 5 percent slopes	A	Severe 2	Slight.
CsC	Corralitos loamy sand, 5 to 9 percent slopes	A	Severe 2	Slight.
CsD	Corralitos loamy sand, 9 to 15 percent slopes	A	Severe 2	Slight.
CtE	Crouch coarse sandy loam, 5 to 30 percent slopes	B	Severe 16	Slight.
CtF	Crouch coarse sandy loam, 30 to 50 percent slopes	B	Severe 1	Moderate.
CuE	Crouch rocky coarse sandy loam, 5 to 30 percent slopes.	B	Severe 16	Moderate.
CuG	Crouch rocky coarse sandy loam, 30 to 70 percent slopes.	B	Severe 1	Moderate.
CvG	Crouch stony fine sandy loam, 30 to 75 percent slopes.	B	Severe 1	Moderate.
DaC	Diablo clay, 2 to 9 percent slopes	D	Slight	Slight. 1/
DaD	Diablo clay, 9 to 15 percent slopes	D	Slight	Slight. 1/
DaE	Diablo clay, 15 to 30 percent slopes	D	Moderate	Slight. 1/
DaE2	Diablo clay, 15 to 30 percent slopes, eroded	D	Moderate 1	Slight. 1/
DaF	Diablo clay, 30 to 50 percent slopes	D	Severe 1	Moderate. 1/

See footnotes at end of table.

TABLE 11.--INTERPRETATIONS FOR LAND MANAGEMENT--Continued

Map symbol	Soil	Hydro-logic group	Erodibility	Limitations for conversion from brush to grass
DcD	Diablo-Urban land complex, 5 to 15 percent slopes:			
	Diablo--	D		
	Urban land--------------------------------------	D		
DcF	Diablo-Urban land complex, 15 to 50 percent slopes:			
	Diablo--	D		
	Urban land--------------------------------------	D		
DoE	Diablo-Olivenhain complex, 9 to 30 percent slopes:			
	Diablo--	D	Moderate 1---	Slight.
	Olivenhain--------------------------------------	D	Moderate 1---	Severe.
EdC	Elder shaly fine sandy loam, 2 to 9 percent slopes------	B	Moderate 2---	Slight.
EsC	Escondido very fine sandy loam, 5 to 9 percent slopes.	C	Severe 16----	Slight.
EsD2	Escondido very fine sandy loam, 9 to 15 percent slopes, eroded.	C	Severe 16----	Slight.
EsE2	Escondido very fine sandy loam, 15 to 30 percent slopes, eroded.	C	Severe 16----	Slight.
EvC	Escondido very fine sandy loam, deep, 5 to 9 percent slopes.	C	Severe 16----	Slight.
ExE	Exchequer rocky silt loam, 9 to 30 percent slopes-------	D	Severe 9-----	Severe.
ExG	Exchequer rocky silt loam, 30 to 70 percent slopes------	D	Severe 1-----	Severe.
FaB	Fallbrook sandy loam, 2 to 5 percent slopes------------	C	Severe 16----	Slight.
FaC	Fallbrook sandy loam, 5 to 9 percent slopes------------	C	Severe 16----	Slight.
FaC2	Fallbrook sandy loam, 5 to 9 percent slopes, eroded-----	C	Severe 16----	Slight.
FaD2	Fallbrook sandy loam, 9 to 15 percent slopes, eroded----	C	Severe 16----	Slight.
FaE2	Fallbrook sandy loam, 15 to 30 percent slopes, eroded--	C	Severe 16----	Slight.
FaE3	Fallbrook sandy loam, 9 to 30 percent slopes, severely eroded.	C	Severe 16----	Severe.
FeC	Fallbrook rocky sandy loam, 5 to 9 percent slopes-------	C	Severe 16----	Slight.
FeE	Fallbrook rocky sandy loam, 9 to 30 percent slopes------	C	Severe 16----	Moderate.
FeE2	Fallbrook rocky sandy loam, 9 to 30 percent slopes, eroded.	C	Severe 16----	Moderate.
FvD	Fallbrook-Vista sandy loams, 9 to 15 percent slopes:			
	Fallbrook---------------------------------------	C	Severe 16----	Slight.
	Vista---	B	Severe 16----	Moderate.
FvE	Fallbrook-Vista sandy loams, 15 to 30 percent slopes:			
	Fallbrook---------------------------------------	C	Severe 16----	Slight.
	Vista---	B	Severe 16----	Moderate.
FwF	Friant fine sandy loam, 30 to 50 percent slopes---------	D	Severe 9-----	Severe.
FxE	Friant rocky fine sandy loam, 9 to 30 percent slopes.	D	Severe 9-----	Severe.
FxG	Friant rocky fine sandy loam, 30 to 70 percent slopes.	D	Severe 1-----	Severe.
GaE	Gaviota fine sandy loam, 9 to 30 percent slopes---------	D	Severe 9-----	Severe.
GaF	Gaviota fine sandy loam, 30 to 50 percent slopes--------	D	Severe 1-----	Severe.
GoA	Grangeville fine sandy loam, 0 to 2 percent slopes------	B	Severe 16----	Slight.
GrA	Greenfield sandy loam, 0 to 2 percent slopes-----------	B	Severe 16----	Slight.
GrB	Greenfield sandy loam, 2 to 5 percent slopes-----------	B	Severe 16----	Slight.
GrC	Greenfield sandy loam, 5 to 9 percent slopes-----------	B	Severe 16----	Slight.
GrD	Greenfield sandy loam, 9 to 15 percent slopes----------	B	Severe 16----	Slight.
HaG	Hambright gravelly clay loam, 30 to 75 percent slopes.	D	Severe 1-----	Moderate.
HmD	Holland fine sandy loam, 5 to 15 percent slopes---------	C	Severe 16----	Slight.
HmE	Holland fine sandy loam, 15 to 30 percent slopes--------	C	Severe 16----	Slight.
HnE	Holland stony fine sandy loam, 5 to 30 percent slopes.	C	Severe 16----	Moderate.

See footnotes at end of table.

TABLE 11.--INTERPRETATIONS FOR LAND MANAGEMENT--Continued

Map symbol	Soil	Hydro-logic group	Erodibility	Limitations for conversion from brush to grass
VaB	Visalia sandy loam, 2 to 5 percent slopes----------------	B	Severe 16----	Slight.
VaC	Visalia sandy loam, 5 to 9 percent slopes----------------	B	Severe 16----	Slight.
VaD	Visalia sandy loam, 9 to 15 percent slopes---------------	B	Severe 16----	Slight.
VbB	Visalia gravelly sandy loam, 2 to 5 percent slopes-------	B	Severe 16----	Slight.
VbC	Visalia gravelly sandy loam, 5 to 9 percent slopes-------	B	Severe 16----	Slight.
VsC	Vista coarse sandy loam, 5 to 9 percent slopes-----------	B	Moderate 2---	Slight.
VsD	Vista coarse sandy loam, 9 to 15 percent slopes----------	B	Moderate 2---	Slight.
VsD2	Vista coarse sandy loam, 9 to 15 percent slopes, eroded.	B	Moderate 2---	Slight.
VsE	Vista coarse sandy loam, 15 to 30 percent slopes---------	B	Moderate 2---	Slight.
VsE2	Vista coarse sandy loam, 15 to 30 percent slopes, eroded.	B	Moderate 2---	Slight.
* VsG	Vista coarse sandy loam, 30 to 65 percent slopes---------	B	Severe 1------	Moderate.
VvD	Vista rocky coarse sandy loam, 5 to 15 percent slopes.	B	Moderate 2----	Moderate. 3/
VvE	Vista rocky coarse sandy loam, 15 to 30 percent slopes.	B	Moderate 2----	Moderate. 3/
VvG	Vista rocky coarse sandy loam, 30 to 65 percent slopes.	B	Severe 1------	Moderate. 3/
WmB	Wyman loam, 2 to 5 percent slopes------------------------	C	Moderate 2----	Slight.
WmC	Wyman loam, 5 to 9 percent slopes------------------------	C	Moderate 2----	Slight.
WmD	Wyman loam, 9 to 15 percent slopes-----------------------	C	Moderate 2----	Slight.

1/ Typically a grassland soil; conversion from brush usually not necessary.

2/ Moderate if slope is more than 30 percent, slight if less than 30 percent.

3/ Stoniness or rockiness not a serious impediment to use of grass-planting equipment.

4/ On desert-facing mountain slopes and in valleys, in the eastern part of land resource area 20, the degree of limitation is severe because of climate, regardless of soil properties.

Table 3-1
RUNOFF COEFFICIENTS FOR URBAN AREAS

Land Use		Runoff Coefficient "C"				
			Soil Type			
NRCS Elements	County Elements	% IMPER.	A	B	C	D
Undisturbed Natural Terrain (Natural)	Permanent Open Space	0*	0.20	0.25	0.30	0.35
Low Density Residential (LDR)	Residential, 1.0 DU/A or less	10	0.27	0.32	0.36	0.41
Low Density Residential (LDR)	Residential, 2.0 DU/A or less	20	0.34	0.38	0.42	0.46
Low Density Residential (LDR)	Residential, 2.9 DU/A or less	25	0.38	0.41	0.45	0.49
Medium Density Residential (MDR)	Residential, 4.3 DU/A or less	30	0.41	0.45	0.48	0.52
Medium Density Residential (MDR)	Residential, 7.3 DU/A or less	40	0.48	0.51	0.54	0.57
Medium Density Residential (MDR)	Residential, 10.9 DU/A or less	45	0.52	0.54	0.57	0.60
Medium Density Residential (MDR)	Residential, 14.5 DU/A or less	50	0.55	0.58	0.60	0.63
High Density Residential (HDR)	Residential, 24.0 DU/A or less	65	0.66	0.67	0.69	0.71
High Density Residential (HDR)	Residential, 43.0 DU/A or less	80	0.76	0.77	0.78	0.79
Commercial/Industrial (N. Com)	Neighborhood Commercial	80	0.76	0.77	0.78	0.79
Commercial/Industrial (G. Com)	General Commercial	85	0.80	0.80	0.81	0.82
Commercial/Industrial (O.P. Com)	Office Professional/Commercial	90	0.83	0.84	0.84	0.85
Commercial/Industrial (Limited I.)	Limited Industrial	90	0.83	0.84	0.84	0.85
Commercial/Industrial (General I.)	General Industrial	95	0.87	0.87	0.87	0.87

*The values associated with 0% impervious may be used for direct calculation of the runoff coefficient as described in Section 3.1.2 (representing the pervious runoff coefficient, Cp, for the soil type), or for areas that will remain undisturbed in perpetuity. Justification must be given that the area will remain natural forever (e.g., the area is located in Cleveland National Forest).

DU/A = dwelling units per acre

NRCS = National Resources Conservation Service

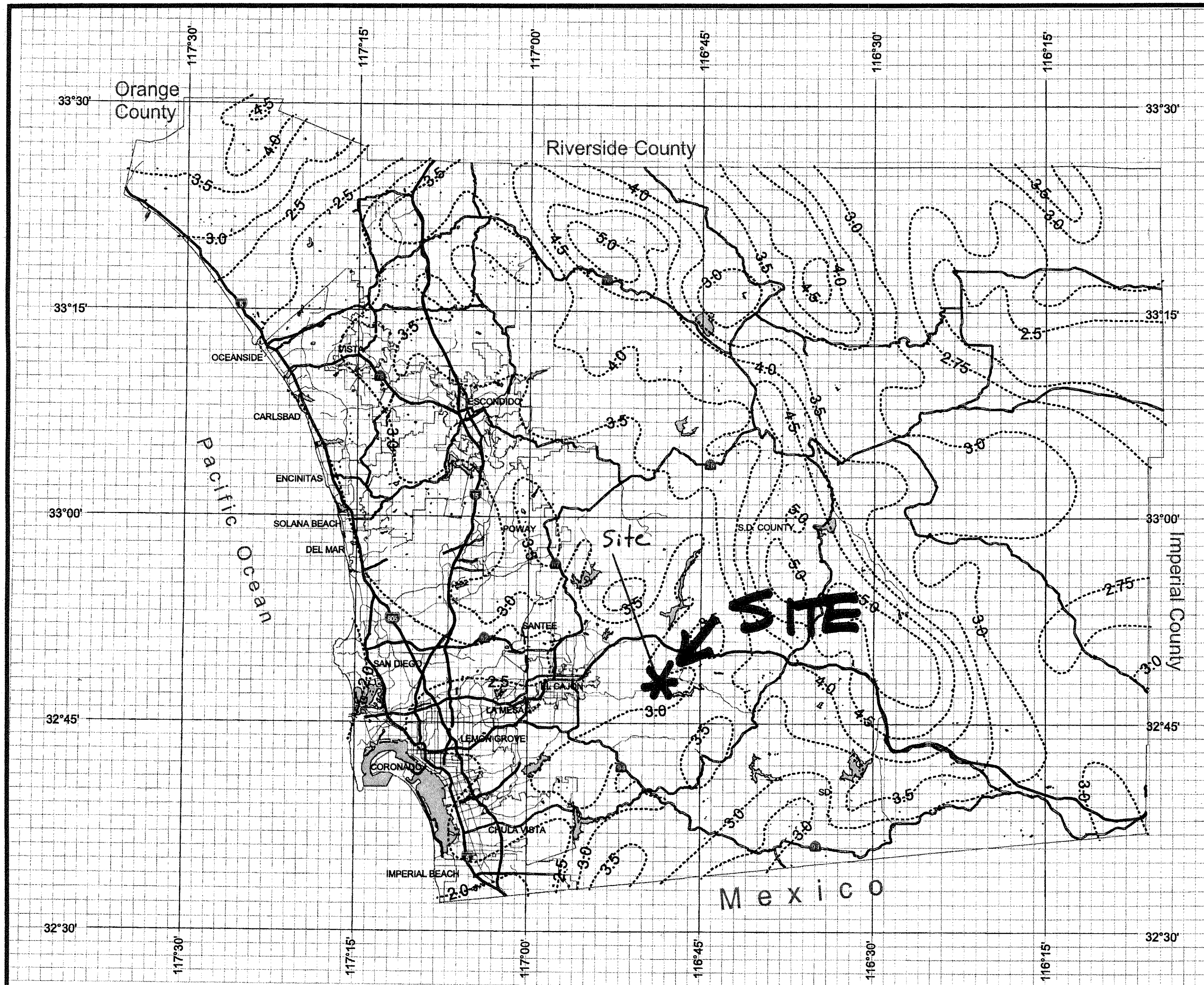
County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 6 Hours

-------- Isopluvial (inches)

$i = 2.9$



DPW GIS
Department of Public Works
Geographic Information Services

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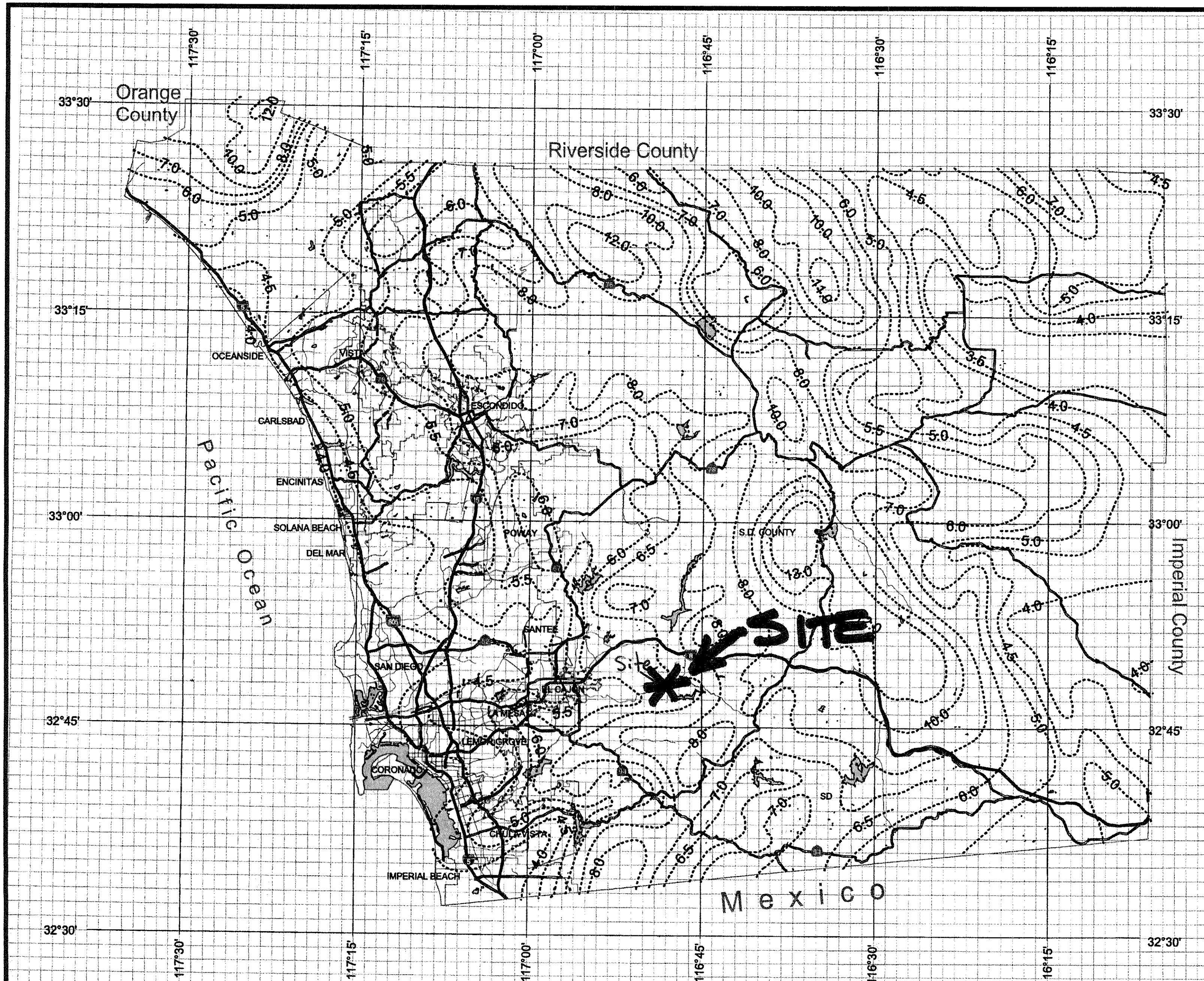


County of San Diego Hydrology Manual

Rainfall Isopluviials

100 Year Rainfall Event - 24 Hours

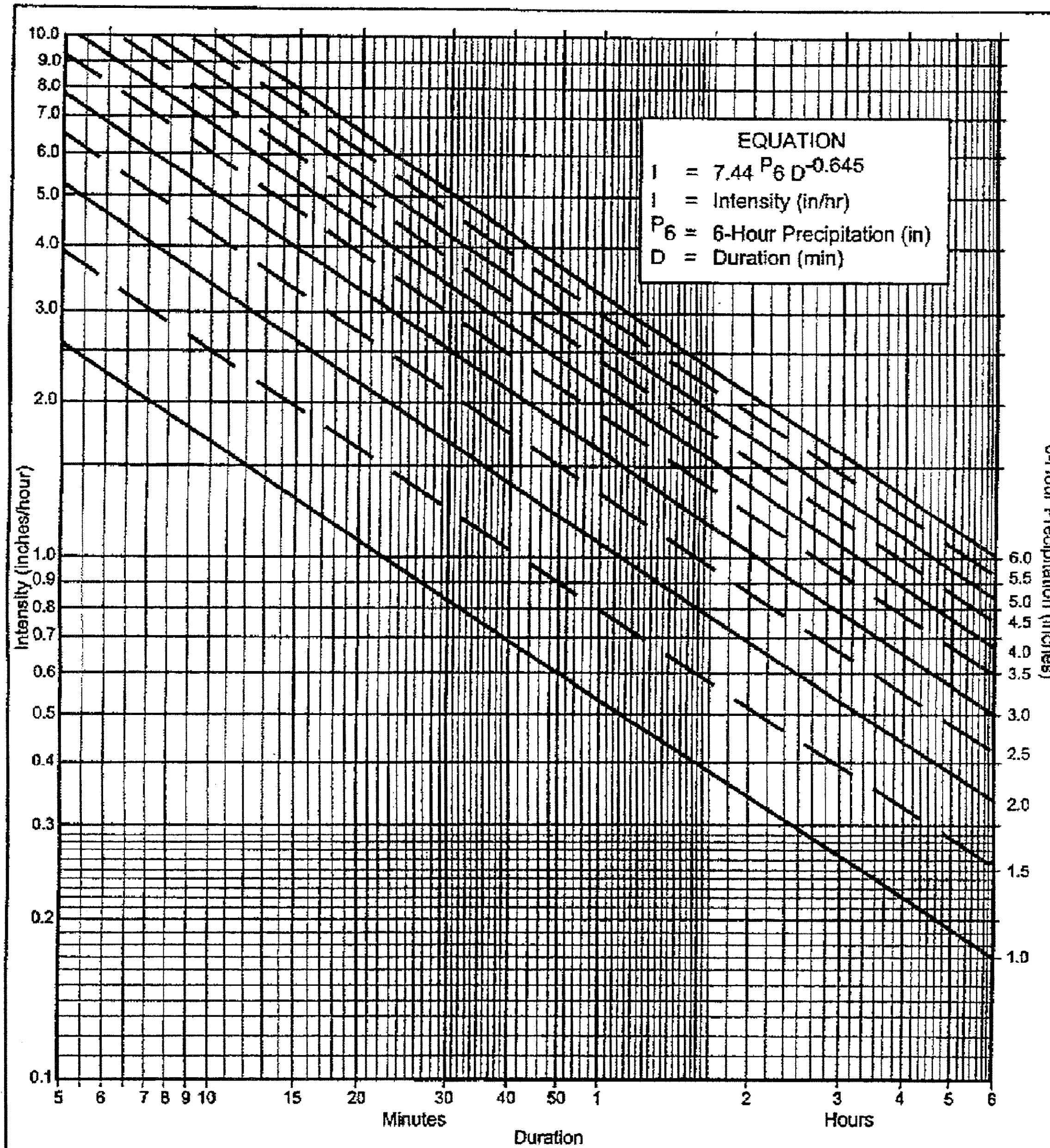
------- Isopluvial (inches)

i: 6.4

DPW GIS
Department of Public Works
Geographic Information Services

SanGIS
We Have San Diego Covered!

3 0 3 Miles



Directions for Application:

(1) From precipitation maps determine 6 hr and 24 hr amounts for the selected frequency. These maps are included in the County Hydrology Manual (10, 50, and 100 yr maps included in the Design and Procedure Manual).

(2) Adjust 6 hr precipitation (if necessary) so that it is within the range of 45% to 65% of the 24 hr precipitation (not applicaple to Desert).

(3) Plot 6 hr precipitation on the right side of the chart.

(4) Draw a line through the point parallel to the plotted lines.

(5) This line is the intensity-duration curve for the location being analyzed.

Application Form:

(a) Selected frequency 100 year

(b) $P_6 =$ 2.9 in., $P_{24} =$ 6.4, $\frac{P_6}{P_{24}} =$ 45 %[(2)]

(c) Adjusted $P_6^{(2)} =$ ______ in.

(d) $t_x =$ Varies min.

(e) I = Varies in./hr.

Note: This chart replaces the Intensity-Duration-Frequency curves used since 1965.

P6	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
Duration	I	I	I	I	I	I	I	I	I	I	I
5	2.63	3.95	5.27	6.59	7.90	9.22	10.54	11.86	13.17	14.49	15.81
7	2.12	3.18	4.24	5.30	6.36	7.42	8.48	9.54	10.60	11.66	12.72
10	1.68	2.53	3.37	4.21	5.05	5.90	6.74	7.58	8.42	9.27	10.11
15	1.30	1.95	2.59	3.24	3.89	4.54	5.19	5.84	6.49	7.13	7.78
20	1.08	1.62	2.15	2.69	3.23	3.77	4.31	4.85	5.39	5.93	6.46
25	0.93	1.40	1.87	2.33	2.80	3.27	3.73	4.20	4.67	5.13	5.60
30	0.83	1.24	1.66	2.07	2.49	2.90	3.32	3.73	4.15	4.56	4.98
40	0.69	1.03	1.38	1.72	2.07	2.41	2.76	3.10	3.45	3.79	4.13
50	0.60	0.90	1.19	1.49	1.79	2.09	2.39	2.69	2.98	3.28	3.58
60	0.53	0.80	1.06	1.33	1.59	1.86	2.12	2.39	2.65	2.92	3.18
90	0.41	0.61	0.82	1.02	1.23	1.43	1.63	1.84	2.04	2.25	2.45
120	0.34	0.51	0.68	0.85	1.02	1.19	1.36	1.53	1.70	1.87	2.04
150	0.29	0.44	0.59	0.73	0.88	1.03	1.18	1.32	1.47	1.62	1.76
180	0.26	0.39	0.52	0.65	0.78	0.91	1.04	1.18	1.31	1.44	1.57
240	0.22	0.33	0.43	0.54	0.65	0.76	0.87	0.98	1.08	1.19	1.30
300	0.19	0.28	0.38	0.47	0.56	0.66	0.75	0.85	0.94	1.03	1.13
360	0.17	0.25	0.33	0.42	0.50	0.58	0.67	0.75	0.84	0.92	1.00

Intensity-Duration Design Chart - Template

FIGURE

3-1

Note that the Initial Time of Concentration should be reflective of the general land-use at the upstream end of a drainage basin. A single lot with an area of two or less acres does not have a significant effect where the drainage basin area is 20 to 600 acres.

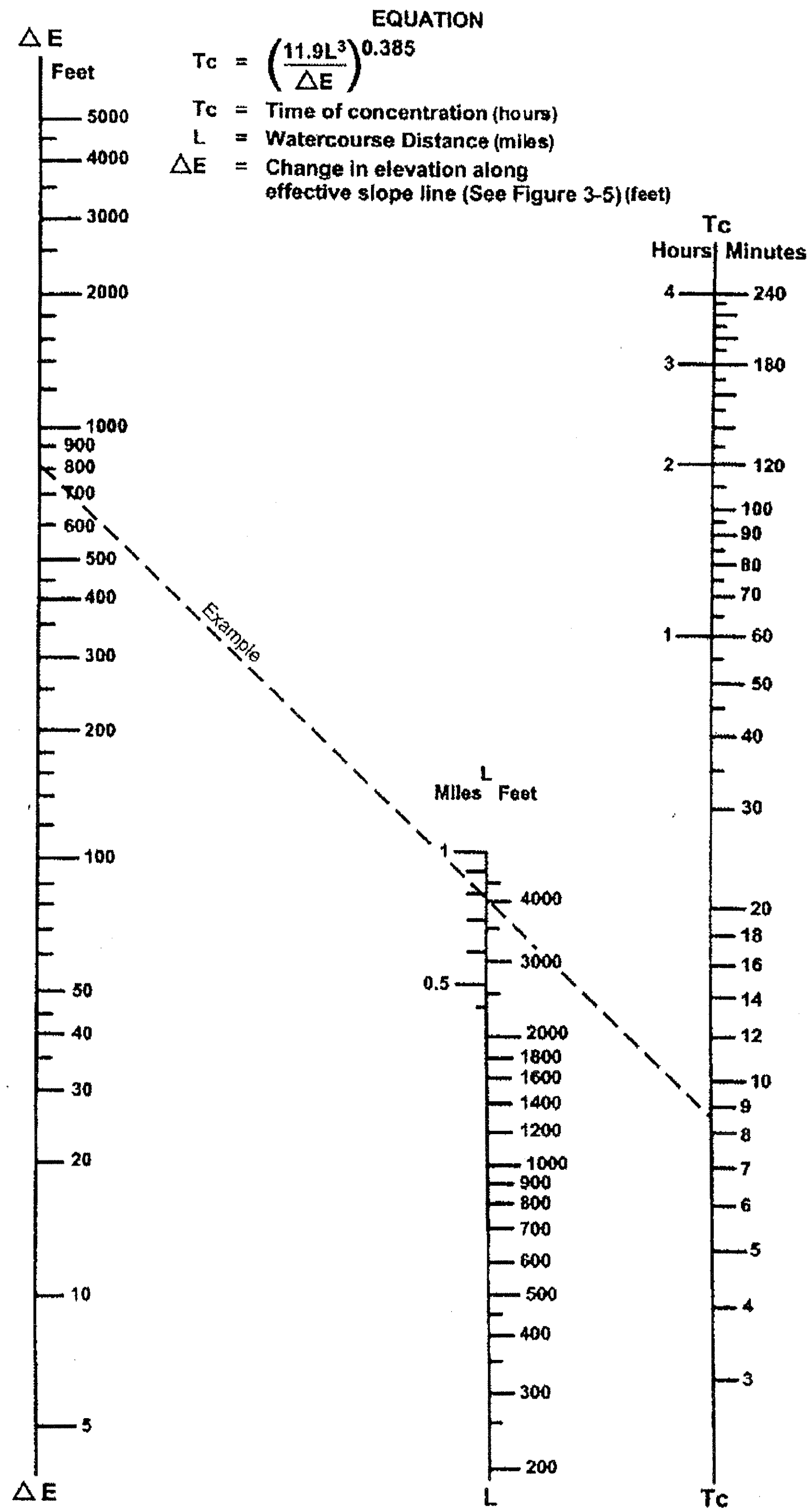
Table 3-2 provides limits of the length (Maximum Length (L_M)) of sheet flow to be used in hydrology studies. Initial T_i values based on average C values for the Land Use Element are also included. These values can be used in planning and design applications as described below. Exceptions may be approved by the "Regulating Agency" when submitted with a detailed study.

Table 3-2

MAXIMUM OVERLAND FLOW LENGTH (L_M) & INITIAL TIME OF CONCENTRATION (T_i)

Element*	DU/	.5%		1%		2%		3%		5%		10%	
	Acre	L_M	T_i	L_M	T_i	L_M	T_i	L_M	T_i	L_M	T_i	L_M	T_i
Natural		50	13.2	70	12.5	85	10.9	100	10.3	100	8.7	100	6.9
LDR	1	50	12.2	70	11.5	85	10.0	100	9.5	100	8.0	100	6.4
LDR	2	50	11.3	70	10.5	85	9.2	100	8.8	100	7.4	100	5.8
LDR	2.9	50	10.7	70	10.0	85	8.8	95	8.1	100	7.0	100	5.6
MDR	4.3	50	10.2	70	9.6	80	8.1	95	7.8	100	6.7	100	5.3
MDR	7.3	50	9.2	65	8.4	80	7.4	95	7.0	100	6.0	100	4.8
MDR	10.9	50	8.7	65	7.9	80	6.9	90	6.4	100	5.7	100	4.5
MDR	14.5	50	8.2	65	7.4	80	6.5	90	6.0	100	5.4	100	4.3
HDR	24	50	6.7	65	6.1	75	5.1	90	4.9	95	4.3	100	3.5
HDR	43	50	5.3	65	4.7	75	4.0	85	3.8	95	3.4	100	2.7
N. Com		50	5.3	60	4.5	75	4.0	85	3.8	95	3.4	100	2.7
G. Com		50	4.7	60	4.1	75	3.6	85	3.4	90	2.9	100	2.4
O.P./Com		50	4.2	60	3.7	70	3.1	80	2.9	90	2.6	100	2.2
Limited I.		50	4.2	60	3.7	70	3.1	80	2.9	90	2.6	100	2.2
General I.		50	3.7	60	3.2	70	2.7	80	2.6	90	2.3	100	1.9

*See Table 3-1 for more detailed description



SOURCE: California Division of Highways (1941) and Kirpich (1940)

Nomograph for Determination of
Time of Concentration (Tc) or Travel Time (Tt) for Natural Watersheds

FIGURE

3-4

Appendix II: 100-Year Lines Of Inundation

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name:

Comment: SECTION 1

Solve For Depth

Given Input Data:

Left Side Slope..	3.62:1 (H:V)
Right Side Slope.	3.88:1 (H:V)
Manning's n......	0.030
Channel Slope....	0.1190 ft/ft
Discharge........	40.00 cfs

Computed Results:

Depth............	1.01 ft
Velocity.........	10.56 fps
Flow Area........	3.79 sf
Flow Top Width...	7.54 ft
Wetted Perimeter.	7.80 ft
Critical Depth...	1.48 ft
Critical Slope...	0.0152 ft/ft
Froude Number....	2.62 (flow is Supercritical)

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name:

Comment: SECTION 2

Solve For Depth

Given Input Data:

Left Side Slope..	5.08:1 (H:V)
Right Side Slope.	5.68:1 (H:V)
Manning's n......	0.030
Channel Slope....	0.0680 ft/ft
Discharge........	40.00 cfs

Computed Results:

Depth............	0.97 ft
Velocity.........	7.89 fps
Flow Area........	5.07 sf
Flow Top Width...	10.45 ft
Wetted Perimeter.	10.63 ft
Critical Depth...	1.28 ft
Critical Slope...	0.0156 ft/ft
Froude Number....	2.00 (flow is Supercritical)

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name:

Comment: SECTION 3

Solve For Depth

Given Input Data:

Left Side Slope..	5.74:1 (H:V)
Right Side Slope.	10.20:1 (H:V)
Manning's n......	0.030
Channel Slope....	0.0660 ft/ft
Discharge........	45.00 cfs

Computed Results:

Depth............	0.88 ft
Velocity.........	7.31 fps
Flow Area........	6.15 sf
Flow Top Width...	14.01 ft
Wetted Perimeter.	14.13 ft
Critical Depth...	1.15 ft
Critical Slope...	0.0160 ft/ft
Froude Number....	1.94 (flow is Supercritical)

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name:

Comment: SECTION 4

Solve For Depth

Given Input Data:

Left Side Slope..	3.48:1 (H:V)
Right Side Slope.	7.12:1 (H:V)
Manning's n......	0.030
Channel Slope....	0.0770 ft/ft
Discharge........	45.00 cfs

Computed Results:

Depth............	1.00 ft
Velocity.........	8.53 fps
Flow Area........	5.27 sf
Flow Top Width...	10.57 ft
Wetted Perimeter.	10.78 ft
Critical Depth...	1.35 ft
Critical Slope...	0.0154 ft/ft
Froude Number....	2.13 (flow is Supercritical)

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name:

Comment: SECTION 5

Solve For Depth

Given Input Data:

Left Side Slope..	6.40:1 (H:V)
Right Side Slope.	4.88:1 (H:V)
Manning's n......	0.030
Channel Slope....	0.1180 ft/ft
Discharge........	50.00 cfs

Computed Results:

Depth............	0.93 ft
Velocity.........	10.14 fps
Flow Area........	4.93 sf
Flow Top Width...	10.55 ft
Wetted Perimeter.	10.71 ft
Critical Depth...	1.37 ft
Critical Slope...	0.0152 ft/ft
Froude Number....	2.61 (flow is Supercritical)

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name:

Comment: SECTION 6

Solve For Depth

Given Input Data:

Left Side Slope..	5.36:1 (H:V)
Right Side Slope.	4.86:1 (H:V)
Manning's n......	0.030
Channel Slope....	0.0880 ft/ft
Discharge........	50.00 cfs

Computed Results:

Depth............	1.03 ft
Velocity.........	9.30 fps
Flow Area........	5.38 sf
Flow Top Width...	10.48 ft
Wetted Perimeter.	10.68 ft
Critical Depth...	1.43 ft
Critical Slope...	0.0151 ft/ft
Froude Number....	2.29 (flow is Supercritical)

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name:

Comment: SECTION 7

Solve For Depth

Given Input Data:

Left Side Slope..	3.96:1 (H:V)
Right Side Slope.	4.18:1 (H:V)
Manning's n......	0.030
Channel Slope....	0.1550 ft/ft
Discharge........	55.00 cfs

Computed Results:

Depth............	1.04 ft
Velocity.........	12.40 fps
Flow Area........	4.44 sf
Flow Top Width...	8.50 ft
Wetted Perimeter.	8.75 ft
Critical Depth...	1.63 ft
Critical Slope...	0.0146 ft/ft
Froude Number....	3.02 (flow is Supercritical)

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name:

Comment: SECTION 8

Solve For Depth

Given Input Data:

Left Side Slope..	3.48:1 (H:V)
Right Side Slope.	2.86:1 (H:V)
Manning's n......	0.030
Channel Slope....	0.2370 ft/ft
Discharge........	55.00 cfs

Computed Results:

Depth............	1.06 ft
Velocity.........	15.33 fps
Flow Area........	3.59 sf
Flow Top Width...	6.74 ft
Wetted Perimeter.	7.07 ft
Critical Depth...	1.80 ft
Critical Slope...	0.0145 ft/ft
Froude Number....	3.71 (flow is Supercritical)

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name:

Comment: SECTION 9

Solve For Depth

Given Input Data:

Left Side Slope..	4.00:1 (H:V)
Right Side Slope.	3.46:1 (H:V)
Manning's n......	0.030
Channel Slope....	0.0830 ft/ft
Discharge........	60.00 cfs

Computed Results:

Depth............	1.25 ft
Velocity.........	10.22 fps
Flow Area........	5.87 sf
Flow Top Width...	9.36 ft
Wetted Perimeter.	9.69 ft
Critical Depth...	1.74 ft
Critical Slope...	0.0144 ft/ft
Froude Number....	2.27 (flow is Supercritical)

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name:

Comment: SECTION 10

Solve For Depth

Given Input Data:

Left Side Slope..	5.06:1 (H:V)
Right Side Slope.	6.20:1 (H:V)
Manning's n......	0.030
Channel Slope....	0.1160 ft/ft
Discharge........	60.00 cfs

Computed Results:

Depth............	1.00 ft
Velocity.........	10.55 fps
Flow Area........	5.69 sf
Flow Top Width...	11.32 ft
Wetted Perimeter.	11.49 ft
Critical Depth...	1.48 ft
Critical Slope...	0.0148 ft/ft
Froude Number....	2.62 (flow is Supercritical)

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name:

Comment: SECTION 11

Solve For Depth

Given Input Data:

Left Side Slope..	3.32:1 (H:V)
Right Side Slope.	3.04:1 (H:V)
Manning's n......	0.030
Channel Slope....	0.1750 ft/ft
Discharge........	60.00 cfs

Computed Results:

Depth............	1.16 ft
Velocity.........	13.98 fps
Flow Area........	4.29 sf
Flow Top Width...	7.39 ft
Wetted Perimeter.	7.75 ft
Critical Depth...	1.86 ft
Critical Slope...	0.0143 ft/ft
Froude Number....	3.23 (flow is Supercritical)

Open Channel Flow Module, Version 3.3 (c) 1991
Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name:

Comment: SECTION 12

Solve For Depth

Given Input Data:

Left Side Slope..	4.58:1 (H:V)
Right Side Slope.	5.96:1 (H:V)
Manning's n......	0.030
Channel Slope....	0.0690 ft/ft
Discharge........	90.00 cfs

Computed Results:

Depth............	1.32 ft
Velocity.........	9.76 fps
Flow Area........	9.22 sf
Flow Top Width...	13.94 ft
Wetted Perimeter.	14.20 ft
Critical Depth...	1.78 ft
Critical Slope...	0.0140 ft/ft
Froude Number....	2.11 (flow is Supercritical)

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name:

Comment: SECTION 13

Solve For Depth

Given Input Data:

Left Side Slope..	6.12:1 (H:V)
Right Side Slope.	7.16:1 (H:V)
Manning's n......	0.030
Channel Slope....	0.0370 ft/ft
Discharge........	90.00 cfs

Computed Results:

Depth............	1.36 ft
Velocity.........	7.32 fps
Flow Area........	12.30 sf
Flow Top Width...	18.08 ft
Wetted Perimeter.	18.28 ft
Critical Depth...	1.63 ft
Critical Slope...	0.0143 ft/ft
Froude Number....	1.56 (flow is Supercritical)

Open Channel Flow Module, Version 3.3 (c) 1991
Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: ALPINE RANCH

Comment: SECTION 14

Solve For Depth

Given Input Data:

Left Side Slope..	2.68:1 (H:V)
Right Side Slope.	6.59:1 (H:V)
Manning's n......	0.030
Channel Slope....	0.1190 ft/ft
Discharge........	98.00 cfs

Computed Results:

Depth............	1.30 ft
Velocity.........	12.57 fps
Flow Area........	7.80 sf
Flow Top Width...	12.02 ft
Wetted Perimeter.	12.35 ft
Critical Depth...	1.94 ft
Critical Slope...	0.0137 ft/ft
Froude Number....	2.75 (flow is Supercritical)

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: ALPINE RANCH

Comment: SECTION 15

Solve For Depth

Given Input Data:

Left Side Slope..	5.29:1 (H:V)
Right Side Slope.	2.29:1 (H:V)
Manning's n......	0.030
Channel Slope....	0.1470 ft/ft
Discharge........	98.00 cfs

Computed Results:

Depth............	1.35 ft
Velocity.........	14.22 fps
Flow Area........	6.89 sf
Flow Top Width...	10.22 ft
Wetted Perimeter.	10.63 ft
Critical Depth...	2.11 ft
Critical Slope...	0.0136 ft/ft
Froude Number....	3.05 (flow is Supercritical)

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: ALPINE RANCH

Comment: SECTION 16

Solve For Depth

Given Input Data:

Left Side Slope..	4.68:1 (H:V)
Right Side Slope.	3.59:1 (H:V)
Manning's n......	0.030
Channel Slope....	0.1080 ft/ft
Discharge........	98.00 cfs

Computed Results:

Depth............	1.38 ft
Velocity.........	12.46 fps
Flow Area........	7.86 sf
Flow Top Width...	11.40 ft
Wetted Perimeter.	11.74 ft
Critical Depth...	2.03 ft
Critical Slope...	0.0136 ft/ft
Froude Number....	2.64 (flow is Supercritical)

Triangular Channel Analysis & Design
Open Channel - Uniform Flow

Worksheet Name: CROCKER

Comment: SECTION 17

Solve for Depth

Left Side Slope	5.1	:1 (H:V)
Right Side Slope	5.7	:1 (H:V)
Manning's n	0.030	
Channel Slope	0.010	ft/ft
Discharge	110.0	cfs

Computed Results:

Depth	2.03	ft
Velocity	4.95	fps
Flow Area	22.24	sf
Flow Top Width	21.92	ft
Wetted Perimeter	22.29	ft
Critical Depth	1.92	ft
Critical Slope	0.0136	ft/ft
Froude Number	0.87	

Triangular Channel Analysis & Design
Open Channel - Uniform Flow

Worksheet Name: CROCKER

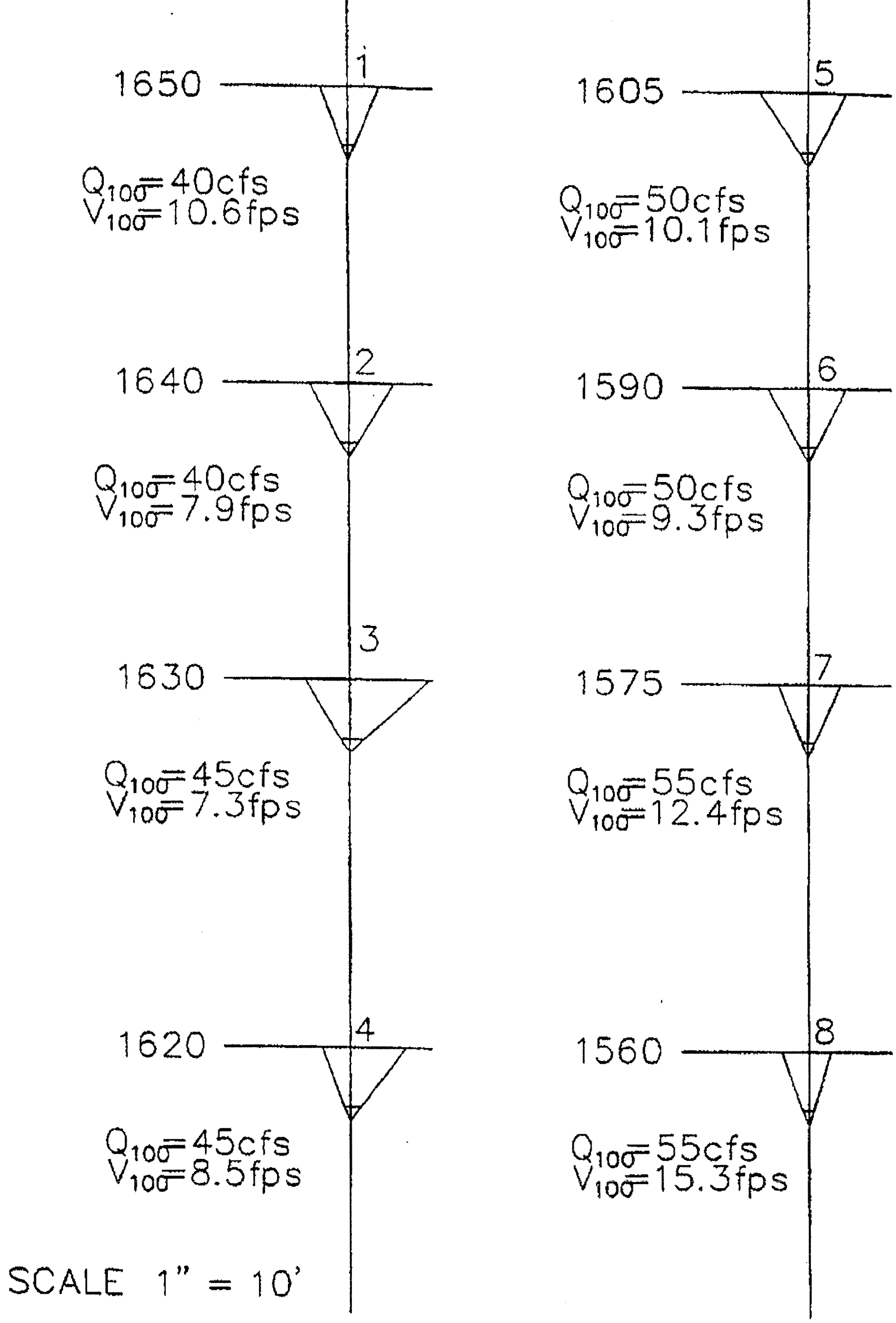
Comment: SECTION 18

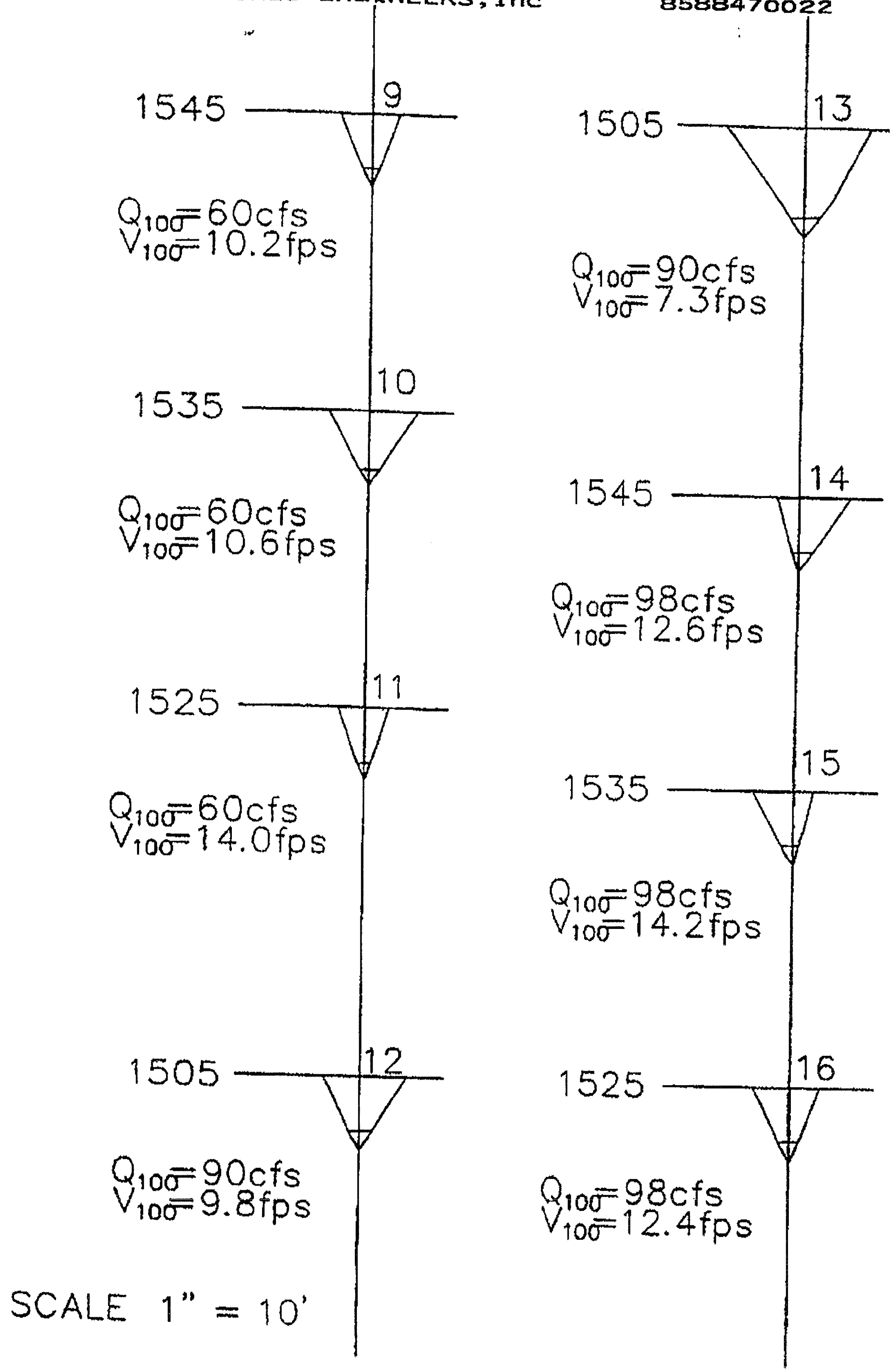
Solve for Depth

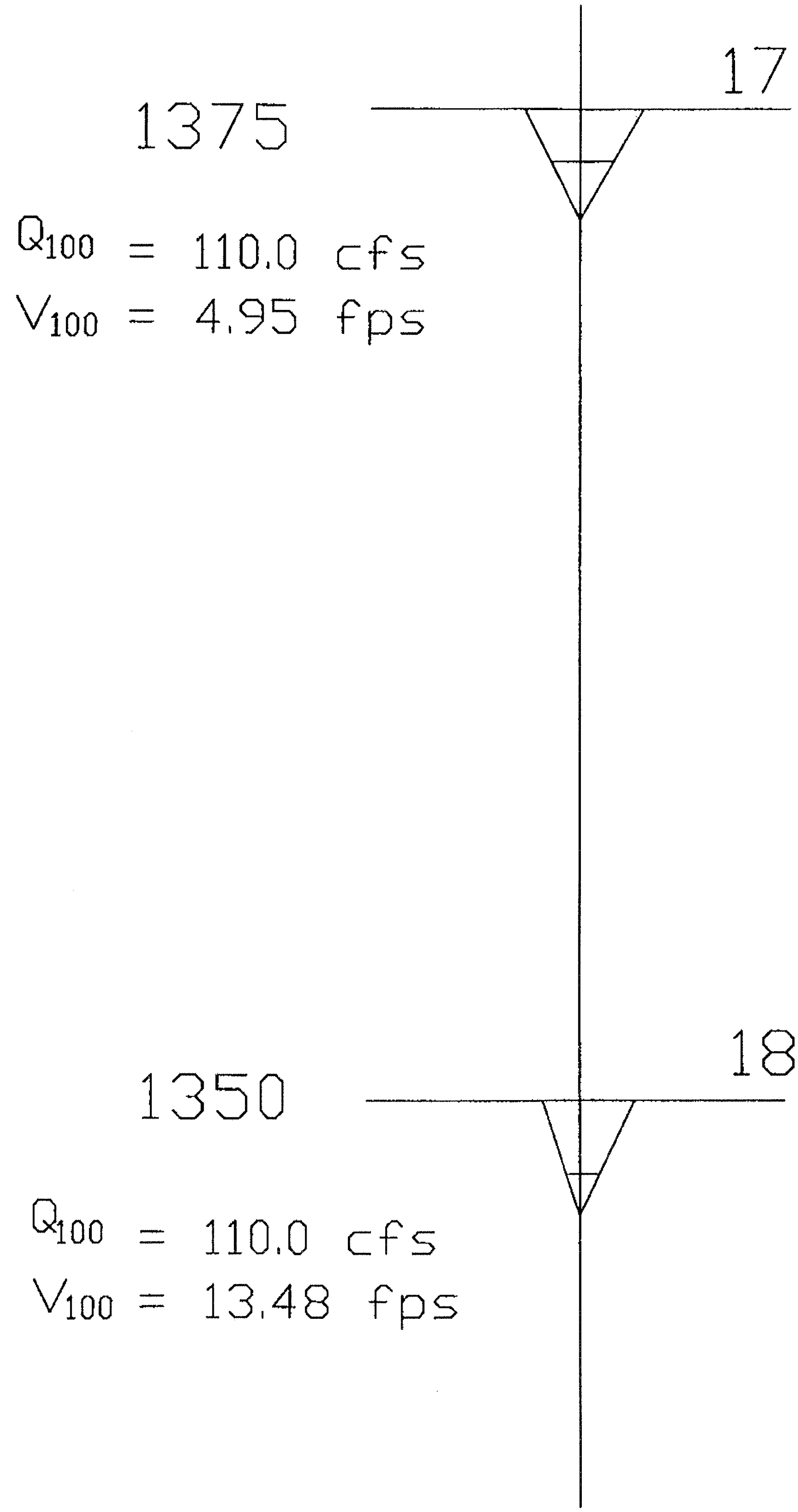
Left Side Slope	4.7	:1 (H:V)
Right Side Slope	3.2	:1 (H:V)
Manning's n	0.030	
Channel Slope	0.120	ft/ft
Discharge	110.0	cfs

Computed Results:

Depth	1.44	ft
Velocity	13.48	fps
Flow Area	8.16	sf
Flow Top Width	11.36	ft
Wetted Perimeter	11.73	ft
Critical Depth	2.17	ft
Critical Slope	0.0133	ft/ft
Froude Number	2.8	


1650
1
Q_{100}= 40cfs
V_{100}= 10.6fps
1640
2
Q_{100}= 40cfs
V_{100}= 7.9fps
1630
3
Q_{100}= 45cfs
V_{100}= 7.3fps
1620
4
Q_{100}= 45cfs
V_{100}= 8.5fps
1605
5
Q_{100}= 50cfs
V_{100}= 10.1fps
1590
6
Q_{100}= 50cfs
V_{100}= 9.3fps
1575
7
Q_{100}= 55cfs
V_{100}= 12.4fps
1560
8
Q_{100}= 55cfs
V_{100}= 15.3fps
SCALE 1" = 10'


1545
9
Q_{100}=60cfs
V_{100}=10.2fps
1535
10
Q_{100}=60cfs
V_{100}=10.6fps
1525
11
Q_{100}=60cfs
V_{100}=14.0fps
1505
12
Q_{100}=90cfs
V_{100}=9.8fps
1505
13
Q_{100}=90cfs
V_{100}=7.3fps
1545
14
Q_{100}=98cfs
V_{100}=12.6fps
1535
15
Q_{100}=98cfs
V_{100}=14.2fps
1525
16
Q_{100}=98cfs
V_{100}=12.4fps
SCALE 1" = 10'


17
1375
Q_{100} = 110.0 cfs
V_{100} = 4.95 fps
18
1350
Q_{100} = 110.0 cfs
V_{100} = 13.48 fps

SCALE 1" = 10'

Appendix III: Time of Concentration and Peak Flow Analysis

Culvert Analysis

DRAINAGE BASIN
CONVEYANCE CALCULATIONS
(RATIONAL METHOD)

Run	Area (acres)	Sum Area	C	CxA	Sum CxA	Flowpath Desc.	Flow Length (ft)	E1 (ft)	E2 (ft)	h (ft)	Slope (ft/ft)	T_C (min)	I_{100} (in/hr)	Q_{100} (cfs)	Pipe diam. (in)	V (ft/s)	Pipe Length (ft)	T_{PIPE} (min)	T_{TOTAL} (min)
		0.00			*0.00*														
L1	91.87		0.36	33.07			refer to attached calculation					22.60							
L2						pipe flow					***total =***	***22.60***	2.98	98.47	48	24.0	90	0.06	22.66
		91.87			***33.07***														
L3	13.63		0.36	4.91		channel	396.8	1360	1295	65	0.164	1.57							
												22.66							
											total =	*24.23*	2.90	110.30					23.49
		105.50			*37.98*														

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: Crocker -Existing Culvert

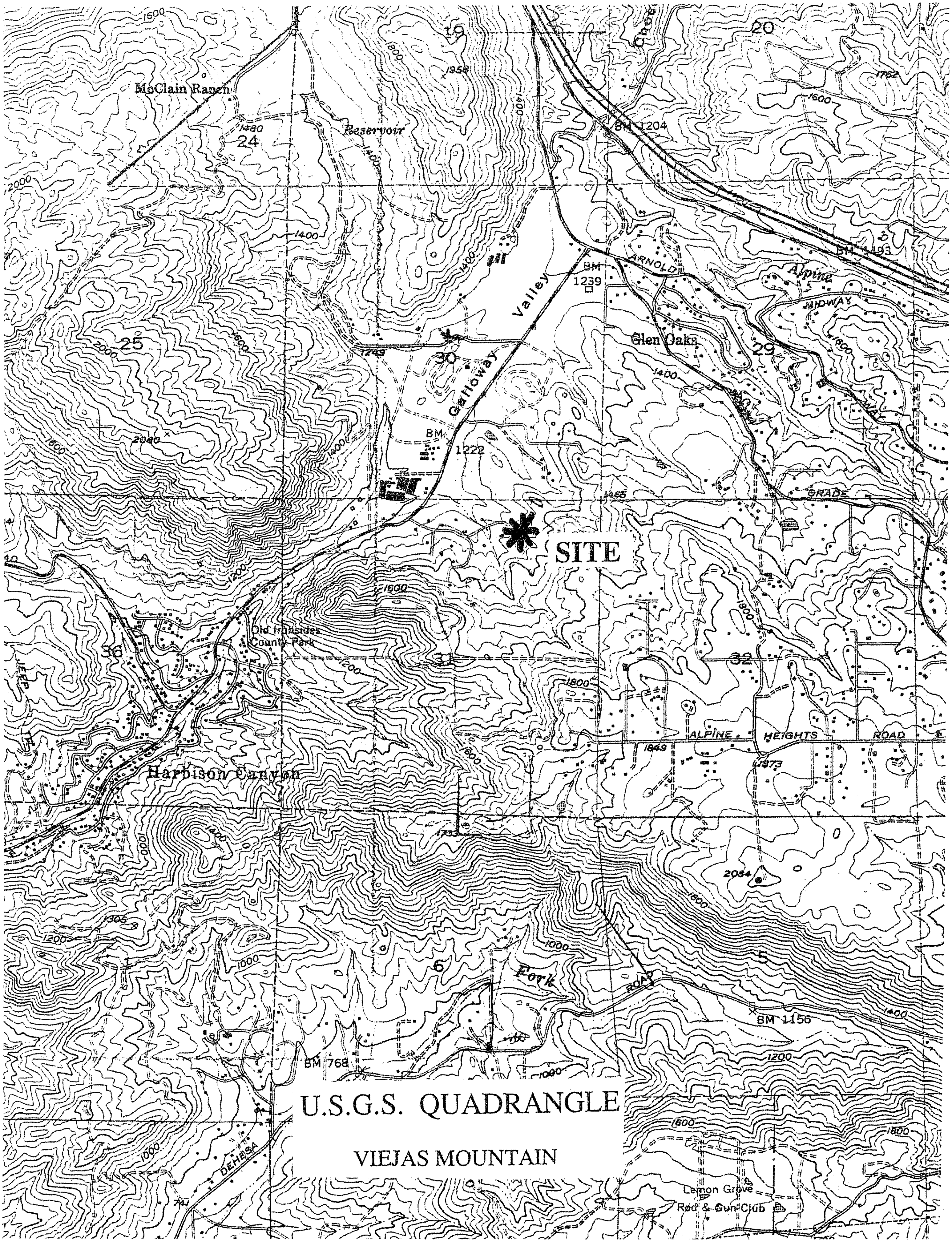
Solve for Actual Depth

Given Input Data:

Diameter	4.0	ft
Slope	0.1880	ft/ft
Manning's n	0.024	
Discharge	110.0	cfs

Computed Results:

Depth	1.57	ft
Velocity	24.01	fps
Flow Area	4.58	sf
Critical Depth	3.17	ft
Critical Slope	0.0213	ft/ft
Percent Full	39.29	%
Full Capacity	337.36	cfs
QMAX @ 0.94D	362.90	cfs
Froude Number	3.91	



U.S.G.S. QUADRANGLE

VIEJAS MOUNTAIN